Plant community development after eleven growing seasons in two experimental wetland basins

William J. Mitsch, Li Zhang and Rachel Mauk

Olentangy River Wetland Research Park, School of Environment and Natural Resources, The Ohio State University

Introduction

We have been monitoring plant cover and species richness in the two experimental basins at the Olentangy River Wetland Research Park (ORWRP) since 1994. In May 1994, Wetland 1 was planted with 2,400 individuals of 13 species of native wetland plants, while Wetland 2 was left unplanted as a control. The hypothesis regarding these basins was that "planted and unplanted basins will be similar in function in the beginning, diverge in function during the middle years and ultimately converge in structure and function" (Mitsch et al., 1998).

This paper presents interpretation of aerial photography of the two experimental wetlands at the ORWRP taken on August 2, 2004, the end of the eleventh growing season for these basins. The previous ten years are summarized by Mitsch and Zhang (2004). Our objective was to determine the spatial patterns of plant community development within the two wetlands, and to determine changes in these communities over previous years.

Methods

A color aerial photograph taken by ODOT on August 2, 2004 (Figure 1) was used to outline the wetland area and dominant vegetation communities for 2004. The photograph was scanned and imported into ArcView 3.2. A number of polygons were digitized according to the plant communities. With spatial analysis in ArcView 3.2, those polygons were exported to raster (gridscale)

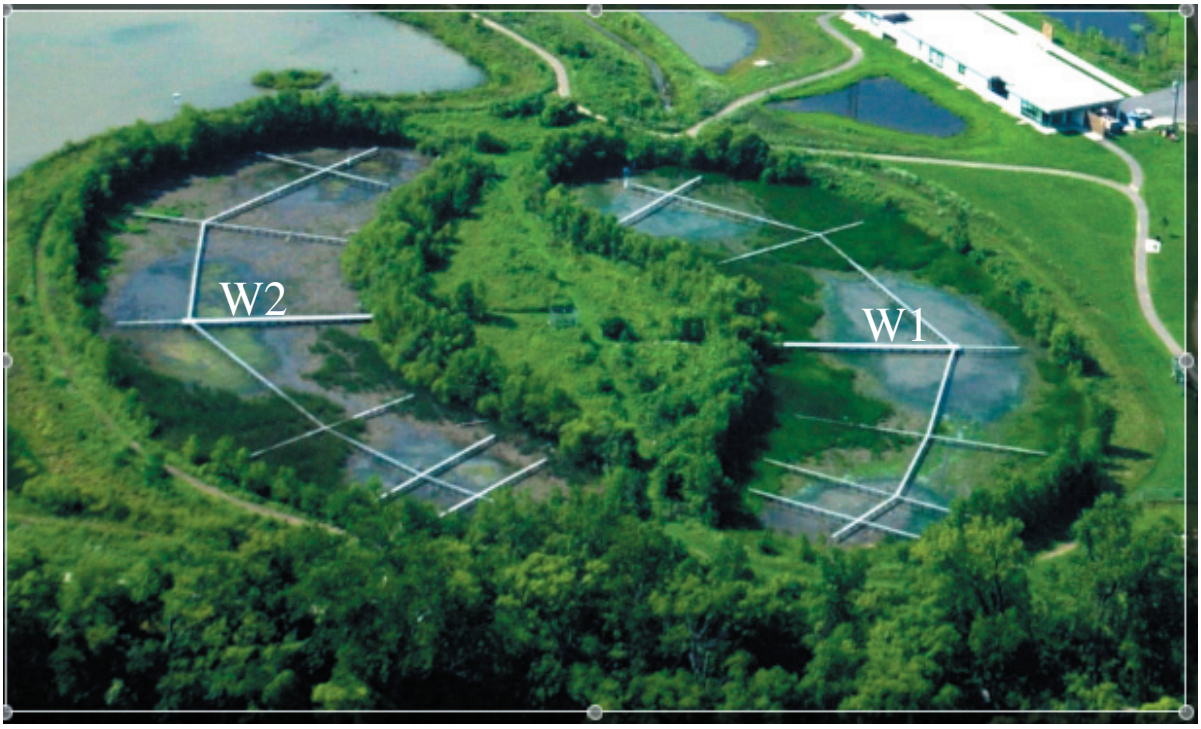


Figure 1. Color aerial photograph of the two experimental wetland basins, Wetland 1 (W1) and Wetland 2 (W2), taken August 2, 2004.

files in order to compute percentage of area occupied by each vegetation community. Maps were ground-truthed by vegetation surveys made from the wetland boardwalks (see following chapeter, this Report).

Results and Discussion

Wetland 1 had approximately 67% macrophyte cover, and Wetland 2 had an estimated macrophyte cover of 42% in August 2004 (Tables 1 and 2; Fig. 2). These values were slightly higher than the 62% and 38% cover in the two wetlands in 2003 and lower than the 73% and 74% cover in Wetlands 1 and respectively in 2002—the highest percent coverage in the basins since they were created in 1993. This decrease is probably due to the sping pulsing of water through the wetlands, in addition to some herbivory. From 1994 when there was no vegetation cover, coverage increased annually in both basins through 1999. Wetland 1 had a greater percent coverage than Wetland 2 until 1997, when that trend reversed. Coverage then decreased in both Wetland 1 and Wetland 2 from 2000 to 2001 as a result of muskrat activity, and possibly increased water levels due to outflow swale sedimentation. Figure 3 illustrates dominant vegation community patterns from 1994 - 2004. The overall pattern of vegetation can be summarized in several distinct periods:

1. Initial Convergence, 1994-96

Wetland 1 was planted in 1994 and as a result, a distinct pattern of vegetation development around the edge of the wetland was observed in 1995, while the "unplanted" wetland 2 remained relatively free of macrophytes except for an edge zone of cottonwood trees that began to develope on the interior mudflat. By the third year however (1996), *Schoenoplectus tabernaemontani* had made its way to the unplanted wetland, and by the end of the 1996 growing season, it appeared that the planted and unplanted wetlands had converged, with *Schoenoplectus* dominating the plant cover.

Table 1. Total coverage (m^2) in each experimental wetland of each dominant macrophyte species in 2004.

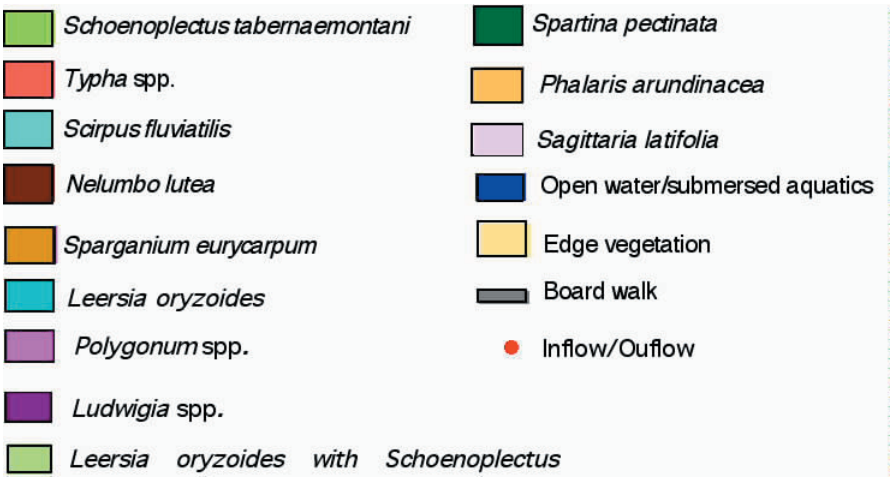
Communitiy	W1	W2
Emergent Vegetation Community		
Schoenoplectus tab.	1414	1800
Sparganium eurycarpum	3427	0
Typha sp	910	979
Polygonum spp.	0	207
Leersia oryzoides	203	636
Sagittaria	13	
Total Vegetation	5967	3622
Open Water	2936	5257
Total	**8903**	**8672**

2. Typha Takes Over, 1997-99

Typha dominance increased dramatically in Wetland 2 beginning in 1996. *Typha* has generally comprised less than 17% of the emergent vegetation in Wetland 1. By 1999, Wetland 2 was totally dominated by a very productive cover of *Typha,* while Wetland 1 contained a diversity of communities dominated by four species: *Sparganium eurycarpum*, *Schoenoplectus tabernaemontani*, *Typha* spp. and *Scirpus fluviatalis*.

3. Wetland Eatout and Resurrection, 2000-2002

Wetland vegetation began to significantly erode in coverage in 2000, and by 2001 Wetlands 1 and 2 had only



Legend key for Figures 2 and 3 in this chapter.

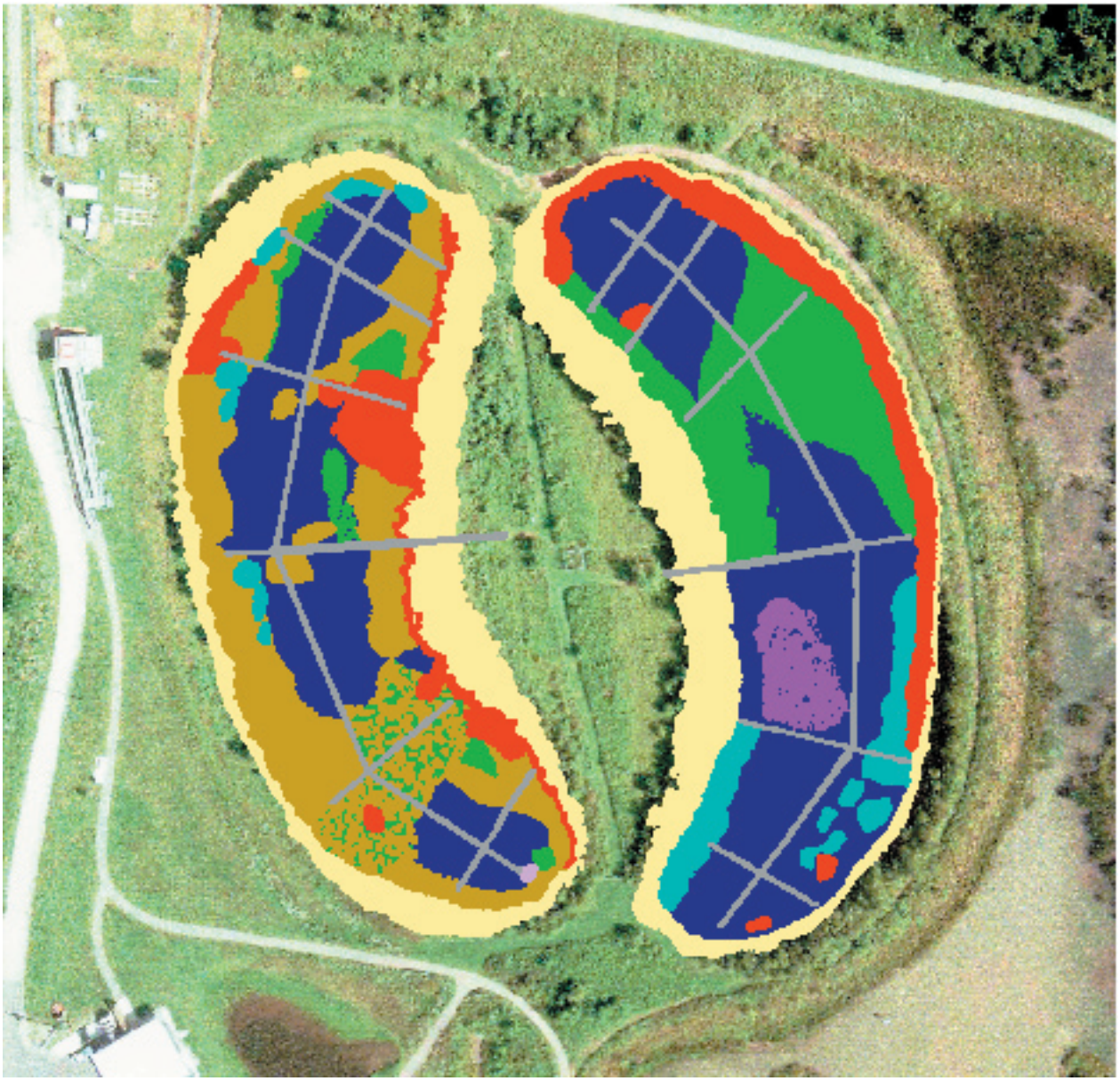


Figure 3. Map of the experimental wetlands from August, 2004 aerial photograph, indicating areas of dominant macrophyte species and open water. See legend on previous page.

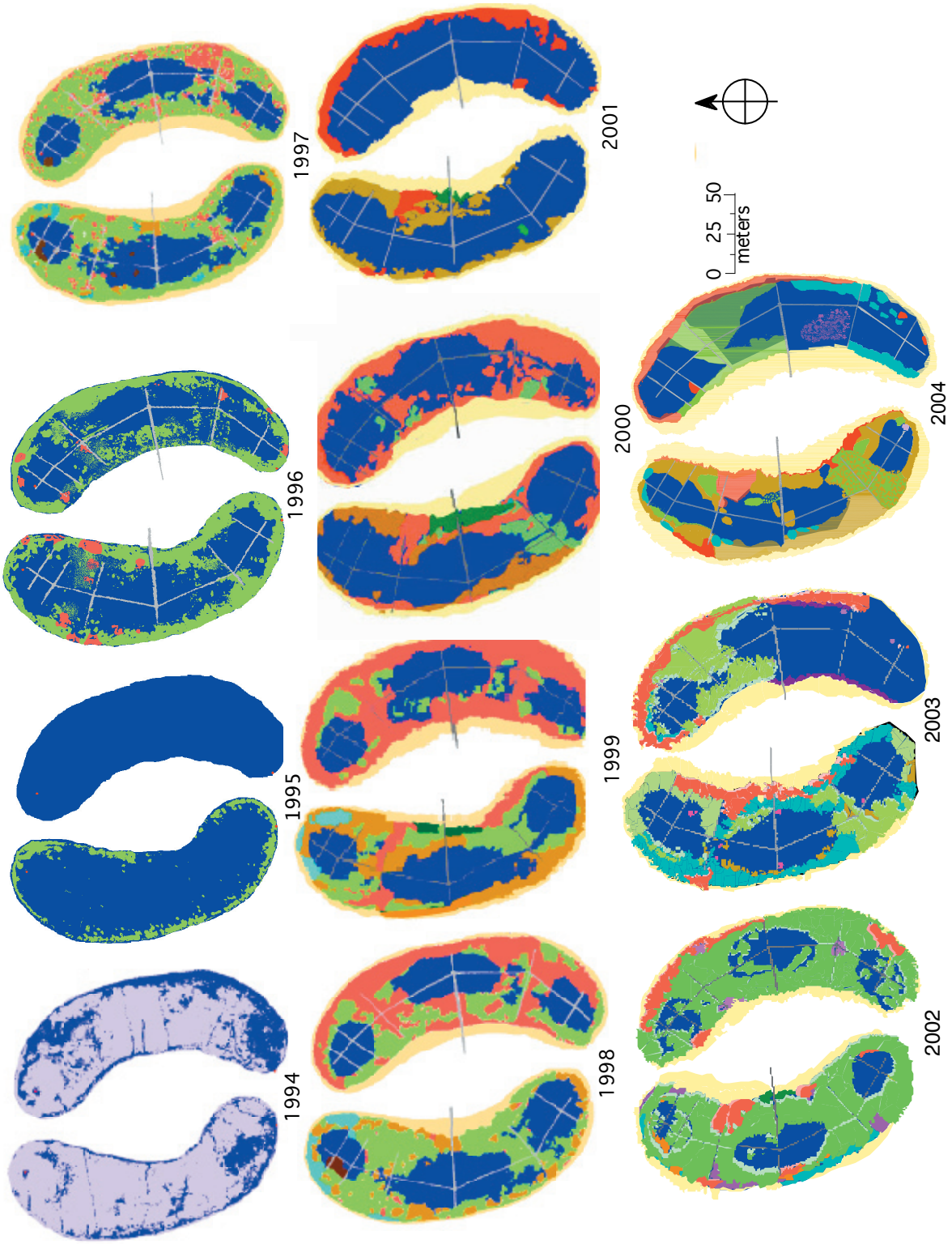


Figure 3. Map of vegetation communities in each experimental wetland from 1994 to 2004. Legend is two pages previous.

Table 2. Dominant vegetation community patterns from 1994-2004 in experimental Wetlands. 1 and 2 (W1 and W2)

Zones that are dominated by (%)	1994 W1	W2	1995 W1	W2	1996 W1	W2	1997 W1	W2	1998 W1	W2	1999 W1
Open water	16.3	29.6	87.0	100.0	59.9	63.4	40.2	35.0	39.2	29.6	36.8
Algal mat	83.7	70.4									
Schoenoplectus tabernaemontani			13.0		36.0	34.8	46.6	48.0	41.2	26.9	21.5
Typha spp.			4.1	1.9	5.0	16.6	1.1	43.5	8.9		
Scirpus fluviatilis						2.3		4.4		2.9	
Nelumbo lutea					1.2	0.4	1.0				
Sparganium eurycarpum						4.7		13.1		25.4	
Sagittaria latifolia						0.1					
Spartina pectinata										4.5	
Phalaris arundinacea											
Polygorum spp.											
Leersia oryzoides											
Leersia oryzoides with *Schoenoplectus*											

Zone that are dominated by (%)	2000 W1	W2	2001 W1	W2	2002 W1	W2	2003 W1	W2	2004 W1	W2
Open water	54.3	51.4	72.4	82.7	27.0	26.0	66.4	31.6	33.0	58.2
Algal mat										
Schoenoplectus tabernaemontani	8.7	3.4	0.3		52.0	63.0	11.8	20.9	15.9	20.8
Typha spp.	16.6	45.2	3.7	17.3	5.0	9.0	7.7	11.6	10.2	11.3
Scirpus fluviatilis	0.2									
Nelumbo lutea										
Sparganium eurycarpum	15.8		21.7		3.0		5.3		38.5	
Sagittaria latifolia									0.2	
Spartina pectinata	4.2		1.8		1.0					
Phalaris arundinacea	0.2									
Polygorum spp.					6.0	2.0	1.2	0.2		2.4
Leersia oryzoides					6.0		25.5	4.1	2.3	7.3
Leersia oryzoides with *Schoenoplectus*							10.8			
Ludwigia								0.8		

27.6% and 17.4% macrophyte coverage respectively. The vegetation loss was caused primarily by muskrat activity (Higgins, 2002) and possibly by sediment buildup in the outflow swale that caused water depth to increase over the years. That is one of the reasons a significant drawdown of both basins was conducted in spring and early summer 2002--to allow the seedbank to reset. This approach was successful. At the end of the 2002 growing season, vegetation coverage was the hightest it had ever been (73-74% cover), and *Typha* coverage was only 9% of the total area of Wetland 2 and 5% of the total area of the originally planted Wetland 1. This was a considerable reduction from 1999, the peak year, when *Typha* occupied 56% of the cover in Wetland 2. One of the most significant changes in 2002 was the increased coverage by *Schoenoplectus tabernaemontani* in both wetlands, apparently due to regeneration from the marsh seedbank. *Schoenoplectus tabernaemontani* (a.k.a. *Scirpus validus*) dominanace increased in both basins in 2002 from 0.3 to 52% coverage in W1 and from 0 to 63% in W2.

4. Pulsing Years, 2003-2004

In January 2004 we continued a pulsing experiment begun in 2003 in the experimental wetlands (see hydrology chapters), where several 7-day floods were pulsed through the wetlands, mostly in late winter and spring. This pulsing was one of the reasons for the shift in the pattern of dominant vegetation communities in the two experimental wetlands. The spring pulses appear to have led to a reduction in macrophyte cover in the wetland basins.

One of the new "communities" that developed in Wetland 1 in 2003 (*Schoenoplectus tabernaemontani-Leersia oryzoides*) were identified in 2004 as two separate communities (*Schoenoplectus tabernaemontani* and *Leersia oryzoides)*. *Polygonum* spp. cover, which was 6 and 2 % respectively in Wetlands 1 and 2 in 2002, attained only 0 and 2% coverage in 2004.

References

Higgins, C. 2002. Ecosystem engineering by musrats (*Ondatra zibethicus)* in created freshwater marshes. Masters thesis, Environmental Science Graduate Program, The Ohio State University, Columbus.

Mitsch, W.J., X. Wu, R.W. Nairn, P.E. Weihe, N. Wang, R. Deal and C.E. Boucher. 1998. Creating and restoring wetlands – an ecosystem experiment in self-design. BioScience 48: 1019-1030.

Mitsch, W.J. and L. Zhang. 2004. Plant community developmnet after ten growing seasons in the two experimental wetland basins. In: W.J. Mitsch, L. Zhang, and C. Tuttle (eds.), Olentangy River Wetland Research Park at the Ohio State University: Annual Report 2003. School of Natural Resources, Columbus, OH, pp. 69-73.